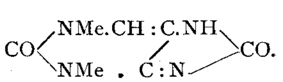
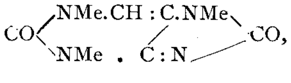
if the book is brought into line with modern physics from time to time, it will command success for many years to come. "Wild Nature won by Kindness" (Fisher Unwin), has attained the eminence of a sixth edition. Mrs. Brightwen's pleasantly written papers on natural history subjects are evidently appreciated by a large public. Three books by Prof. S. Cooke, of the College of Science, Poona, published by Messrs. George Bell and Sons, have also been received. They are "First Principles of Astronomy" (fifth edition), "First Principles of Chemistry" (sixth edition), and "Test Tables for Qualitative Analysis" (third edition.)

THE synthesis of caffeine is the subject of a short communication to the Berlin Academy by Emil Fischer and Lorenz Ach (*Sitzb. König. Preuss. Akad. Wiss. Berlin*, xiv. p. 261). By the condensation of dimethyl urea and malonic acid the substance $CO : (NMe.CO)_2 : CH_2$, is obtained. The nitroso-derivative, $CO : (NMe.CO)_2 : CH.NO$, is reduced to dimethyluramil, $CO : (NMe.CO)_2 : CH.NH_2$, whence dimethylpseudouric acid, $CO : (NMe.CO)_2 : CH.NH.CO.NH_2$, is produced. By abstraction of the elements of water with oxalic acid, dimethyluric acid is formed. This substance is converted into theophylline, an isomeride of theobromine, of the formula



Thence caffeine,



is obtained by the ordinary methyl iodide reaction. As this is the first synthesis of caffeine, details of the methods used will be looked forward to with considerable interest.

THE observation by Martin Freund and Ernst Göbel, that thebaïne is a derivative of phenanthrene (*Ber.* 28, 7, 941) brings this alkaloid into line with morphine and codeïne as instances of the few natural phenanthrene derivatives yet known. Thebaïne is related to dihydrophenanthrene in the same manner as morphine and codeïne are connected with tetrahydrophenanthrene.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*, ♀) from Natal, presented by Mr. Alfred James; a Common Jackal (*Canis aureus*), two Bengal Foxes (*Canis bengalensis*), a Jungle Cat (*Felis chaus*) from India, presented by Dr. John Anderson, F.R.S.; two Short-tailed Capromys (*Capromys brachyurus*) from Jamaica, presented by Mr. Frank Cundall; a Dorsal Squirrel (*Sciurus hypopyrrhus*) from Central America, presented by Mrs. Brett; five Squirrel-like Phalangers (*Belideus sciureus*) from Australia, presented by the Right Hon. Earl Cadogan, K.G., a Cambayan Turtle Dove (*Turtur senegalensis*) from West Africa, presented by Mr. C. L. Sutherland; a Salle's Amazon (*Chrysotis sallæ*) from St. Domingo, presented by Mr. W. Windsor Spriggs; a Spotted Salamander (*Salamandra maculosa*), European, presented by Mr. E. Layton Bennett; two Great Wallaroos (*Macropus robustus*, ♂ ♀), two Agile Wallabies (*Halmaturus agilis*) from Australia, a Blue and Yellow Macaw (*Ara ararauna*) from South America, deposited; two Canada Geese (*Bernicla canadensis*) from North America, two Yellowish Weaver Birds (*Sitagra luteola*) from Tropical Regions, thirteen Green Lizards (*Lacerta viridis*) from Jersey, purchased; a Malaccan Parrakeet (*Palæornis malaccensis*) from Malacca, a Nicobar Pigeon (*Calænas nicobarica*) from the Indian Archipelago, received in exchange; a Bennett's Wallaby (*Halmaturus bennetti*, ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

STARS WITH REMARKABLE SPECTRA.—At those stages of celestial evolution in which the temperature is low, it is probable that the average condensing body will not be very bright, so that the study of their spectra at these phases of their development presents some difficulties. Thus, the great majority of the stars with bright-line spectra, and stars showing intense carbon absorption, are of low magnitudes, and because comparatively few were identified in the earlier surveys of stellar spectra, they were looked upon as "peculiar." Nevertheless, a study of these spectra in relation to those of the brighter stars indicated that they probably represented stages in the history of all condensing bodies, so that their discovery in greater numbers was only to be expected. At Harvard College especially has the photographic investigation of these faint spectra been carried on, and the discovery of eleven more objects with peculiar spectra has been recently announced by Mrs. Fleming; two of these are simply stated to be "peculiar," three are nebulæ with bright lines, two have the F line of hydrogen bright, two appear to be bright-line stars of the Wolf-Rayet type, and two show carbon absorption. In addition, the spectra of eleven stars of the α Herculis type were found to show the F line of hydrogen bright, and this unfailing sign of variability in this group of stars is fully substantiated by an examination of chart plates of the same regions (*Astrophysical Journal*, May.) In his observations of the visual spectra of faint stars, Rev. T. E. Espin has discovered numerous objects which he describes as "remarkable." (*Ast. Nach.* 3286.) Most of these, however, appear to be of the α Herculis type; but some are spectra in which carbon absorption is predominant (Group VI.). The most interesting observations by Mr. Espin are those of variable stars, and they tend to show that, in the stars of Group VI., the variability is accompanied by spectroscopic variations which render it difficult to distinguish them from stars of Group II., in which the carbon flutings are bright.

THE PARIS OBSERVATORY.—The annual report for 1894 indicates a high state of activity in this institution, in many directions besides those with which occasional published papers have made us familiar. Great progress has been made with the star catalogue initiated by Admiral Mouchez in 1882, comprising 350,000 observations made between 1837 and 1881; two additional volumes will be published during the present year, and the last two in 1899; a supplementary couple of volumes, dealing with observations made since 1881, will also be issued very shortly. The number of meridian observations during last year amounted to over 18,000, while observations of sun, moon, and planets total 455. Comets, minor planets, and double stars have also received a vast amount of attention. For the great photographic chart, 278 negatives were taken during the year, and the positions of nearly 33,000 stars on various plates have been measured under the direction of Mdlle. Klumpek.

The reduction of these measures was seriously commenced in November, and up to the end of the year the measures of 11 plates, showing 1760 stars, were completely reduced. Meteorological observations on the usual plan were continued regularly.

The magnificent work on lunar photography with the equatorial coudé, as well as the spectroscopic researches of M. Deslandres, have already been referred to in our columns.

THE ACTION OF LIGHT ON ANIMAL LIFE.

ALTHOUGH a number of investigations have been made on the action of light on bacteria, very few experiments have been carried out to ascertain how direct insolation affects animals inoculated with particular disease microbes. Does exposure to sunshine increase or diminish an animal's susceptibility to disease? De Renzi was, we believe, the first to study this question experimentally, and he endeavoured to answer it as regards tuberculosis by inoculating guinea-pigs with tuberculous material. Some of the animals he kept in glass boxes exposed to the direct rays of the sun for five or six hours daily, whilst others were placed in the sunshine, but instead of glass, wooden boxes were used. De Renzi found that, whilst the guinea-pigs in glass boxes —to which, therefore, the maximum amount of sunshine had access—died after 24, 39, 52, and 89 days, those in the opaque wooden boxes died after 20, 25, 26, and 41 days. Thus it would appear that sunshine materially assisted these animals in combating with tuberculous disease, for those individuals deprived of sunshine succumbed far more rapidly.

More recently, Dr. Masella has carried out a series of similar experiments with guinea-pigs inoculated, however, with cholera

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and typhoid bacilli respectively. Various points were investigated as to whether insolation *previous* to inoculation increased the animal's susceptibility to these diseases, also what was the effect of insolation on the animal after infection, and whether the same results were obtained when the temperature of the surrounding air during insolation was not permitted to rise. The toxic properties of the cholera and typhoid broth cultures employed were carefully tested, and it was ascertained that the lethal dose in the case of cholera, procuring death in twenty-four hours, was secured by employing cultures in the proportion of 0·20 per cent of the weight of the animal operated upon, whilst to obtain similar results with typhoid cultures, 0·40 per cent. of the weight of the animal was the proportion in which they had to be used.

In the case of both cholera and typhoid it was found that previous exposure to sunshine increased the animals' susceptibility to these diseases, for not only did they die more rapidly when subsequently inoculated with these cultures than the guinea-pigs similarly treated, exposed, however, only to diffused light, but they succumbed to smaller doses, and doses which did not prove fatal to the guinea-pigs which had been previously protected from sunshine. When the exposure to sunshine took place *after* infection fatal results were greatly accelerated, for instead of dying in from 15 to 24 hours they succumbed in from 3 to 5 hours. These experiments were, however, open to the objection that the accelerated lethal action through subsequent insolation might be due to the higher temperature which necessarily prevailed in boxes exposed to sunshine over those to which diffused light only was admitted. To dispose of this difficulty, boxes were constructed with double cases through which a current of water was kept circulating; in the "sunshine" boxes, as before, only glass was used, whilst in the "diffused light" boxes the outer case was made of zinc. In spite, however, of these precautions as regards temperature the results confirmed those previously obtained, the insolated animals still exhibiting the same increased susceptibility to infection from these diseases over the non-isolated animals.

Dr. Masella does not attempt to give any explanation of the remarkable results he has obtained, but we would suggest that the action of sunshine should be tried on anti-toxines. It would be of great interest to ascertain how the potency of these protective fluids outside the body was affected by exposure to sunshine, and also what result, if any, isolation had on their generation within the animal system.

We know that the toxic properties or, for example, tetanus cultures may be entirely destroyed in from 15 to 18 hours in direct sunshine at a temperature of from 35° to 43° C., and Roux and Yersin state that five hours' direct insolation greatly modifies the toxic properties of diphtheria cultures; again, Calmette has found that after two weeks' insolation the poison of the *Naya tripudians* is completely destroyed, whilst a similar exposure has a damaging effect on the poison of the rattlesnake. So far as we are aware, the action of sunshine on the immunising properties of serum has not been investigated, and its study should prove of immense interest and importance.

The results obtained by De Renzi with tuberculous infection have a practical confirmation in the acknowledged benefit which patients suffering from tuberculosis derive from residence in places such as Davos, where the maximum amount of sunshine may be secured. On the other hand, Dr. Masella's experiments leave us with an uncomfortable uncertainty as to the wisdom of basking in the sunshine. He would have us believe that his investigations explain the greater prevalence and virulence of typhoid and cholera (which he states as an accepted fact) in hot countries where the sun shines with greater power and more continuously. After all, our smoke-laden atmosphere and dreary yellow fogs may be turned to account seemingly, and the London water companies may congratulate themselves that these two water-borne diseases, *par excellence*, may be made to yield not only to efficient purifying processes at their hands, but that such an unexpected ally, according to Dr. Masella, is to be found in the limited amount of sunshine which Londoners can enjoy!

G. C. Frankland.

THE CONSTRUCTION OF STANDARD THERMOMETERS.

A SERIES of important articles on the preparation and testing of standard thermometers have been communicated to the *Zeitschrift für Instrumentenkunde* by Drs. Pernet, Jaeger, and Gumlich, of the Physikalisch-Technische Reichsanstalt. The selection of the best glass, the calibration of the thermometers, the determination of the coefficients of external and internal pressure, and the verification of the principal points are fully dealt with. One source of error in thermometers as usually constructed, lies in the fact of the bulbs being blown from the tubes. The vaporisation of certain constituents of the glass during this operation leads to a difference of chemical constitution between the stem and the bulb. This may be obviated by making the bulbs out of thin walled tubes of the same kind of glass, and welding them on to the stems. As regards the depression of the freezing point, it was found by Wiebe and Schott, of Jena, that glasses containing either sodium or potassium, but not both, showed this after-effect to the least extent. In order to render the reading of temperatures accurate to within 0°·002, the length of a degree should not be less than 6 mm., and since the length of the stem cannot conveniently exceed 60 cm., the range of measurable temperature is practically limited to 100°. Stem thermometers without enamel backs or enclosing tubes were the only ones found suitable for first-class standards. When certain fixed points outside the scale were to be brought in, this was accomplished by widening out the tube above them. An equal linear division of the scale was adopted, this having great advantages over the more or less untrustworthy division by equal volumes. For calibration, threads of mercury of different lengths were cut off from the main portion and measured with micrometer microscopes, viewing them both through the face and the back of the stem. But the threads were not cut off by local heating, since that is apt to produce a permanent change of capacity. The small and almost microscopic bubble which remains in every thermometer was made use of. It was brought to the entrance of the bulb when the desired portion of the thread had been driven into the stem, and then a slight jerk sufficed to cut off the required length. To facilitate this operation, the bulb was narrowed to a neck at the entrance to the stem. As regards pressure, two factors had to be considered. The external atmospheric pressure, and the pressure of the liquid in which it is immersed, tend to compress the glass vessel and to produce an apparent elevation of temperature. The capillary pressure of the mercury, and its hydrostatic pressure, on the other hand, tend to widen the bulb and produce an apparent cooling. The first of these elements was investigated by exposing the thermometer to various high and low pressures in a glycerine bath, and the second by observing the readings when the thermometer stood horizontally and vertically respectively, at its highest measurable temperature. The capillary pressure was found to be too capricious to be accurately measured, but it is a negligible quantity. The coefficient of apparent expansion of mercury in the new Jena glass thermometer 16^{III} was found to be 0·0001571 between 0° and 100°.

THE INFLUENCE OF MAGNETIC FIELDS UPON ELECTRICAL RESISTANCE.

IT is well known that the resistance (R) of a wire of bismuth, as measured with a constant current, increases under the influence of a magnetic field, and that this increase depends on the strength of the field and its direction with reference to the current in the wire. If the current traversing the bismuth is oscillatory, the resistance has a value O outside the magnetic field, or in a field in which the lines of force are parallel to the wire which is less than R. If, however, the wire is perpendicular to the lines of force of a field greater than 6000 C.G.S. units, the resistance O is greater than R; the difference O – R increases from this point pretty rapidly as the strength of the field increases. These changes are not due to alterations in the self-inductor, since they are independent of the form of the bismuth spiral. This curious phenomenon has lately been examined by M. I. Sadovsky (*Journal de la Société Physico-Chemique de Russe*, xxvi. 1894, and *Journal de Physique*, April 1895), who sums up the results of his experiments as follows: (1) The difference in the resistance of bismuth observed with constant or alternating currents is measurable outside a magnetic field with 300 alternations per second, and can be detected in magnetic fields with only three or four alternations per second; (2) this difference depends on the number of oscillations per second, and without the magnetic field increases with the increase in the frequency of the alternations; (3) the resistance which bismuth, in a strong magnetic field, offers to an increasing current is greater, and that to a decreasing current less than the resistance for steady currents. The difference between the resistances to an increasing and decreasing

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